THE PROGRESS OF THE TELEGRAPH *

VII.

IN 1843 Alexander Bain made certain important improvements in the recording and transmitting instrument shown in Fig. 28, in which two semicircular magnets B B′, with similar poles facing, fixed to a brass bar, move through the centres of two coils, A A′, the index-hand pointing to I or V according to the direction of the current. This was controlled by the metallic contacts N N′ N″ N‴ opening or closing the battery and line circuits according to the position of the handle F. The connection and direction of the current through the instrument from the battery D is indicated by the arrows, the connection R being that of the line wire, and S that of the earth circuit.

This patent and certain others that will be brought under notice gave rise to expensive litigation in the early history of the telegraph. In 1846 John Nott produced his letter-recording telegraph, which, in conjunction with Mr. Alexander Bain's inventions, was carried into the law courts on a question of infringement of the Cooke and Wheatstone patent rights; but for reasons already given regarding patent law, the opposition was unsuccessful on the part of the Electric Telegraph Company.

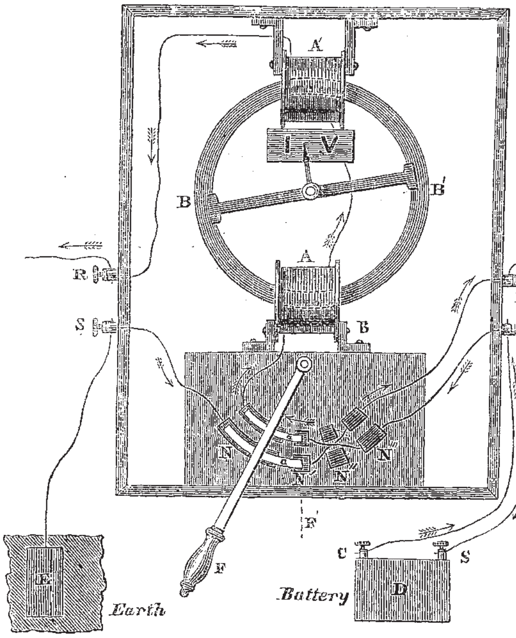

FIG. 28.—Bain's I and V telegraph, 1843.

Nott's apparatus is shown in external and internal elevation in Figs. 29 and 30. It consisted of a dial showing the letters of the alphabet and numerals repeated four times in the circumference of the circle. The respective letters or numerals were indicated by the step-by-step motion of a revolving pointer or index-hand. The motion of this pointer was controlled by successive make-and-break contacts with the battery by means of a finger-key dipping into a mercury cell, *b*. The index-pointer was driven round by a "clawker-and-driver" action in connection with the toothed wheel *c*, the propelling power being derived from the attractive and repellant action of two horseshoe electro-magnets, *a*, *d*, acting upon soft iron armatures in connection with the "clawker-and-driver" motion. The electro-magnet *b* governed the alarum or call-signal. Either the speaking or alarum portion of the telegraph was brought into action by the position of the contact drums, *f*, *f*, which regulated the direction of the battery current through the electro-magnets, by means of the index shown in the external view (Fig. 29) being moved to the one side or the other.

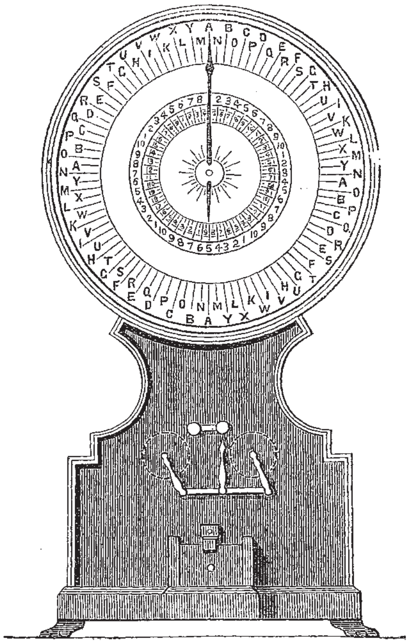

FIG. 29.—Nott and Gamble's patent, 1846. External view.

In 1846 Highton's gold leaf indicator was brought under notice, and an important automatic chemical printer-recording high-speed telegraph, by Alexander Bain, which has been the germ of several of the applications in the modern high-speed automatic arrangements (Fig. 25). In this chemical printer, a paper strip, perforated with holes in symbolic groups to represent the several words of the message, was employed to regulate the automatic sequences of the current through the line. This paper ribbon was passed over a metal drum in circuit with the line wire, and a fine metal style in connection with one pole of the battery

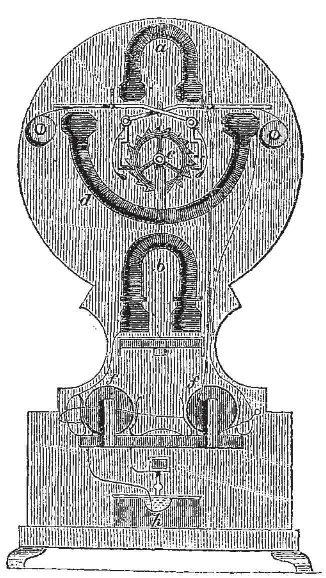

FIG. 30.—Nott and Gamble's patent, 1846. Internal arrangement.

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* Continued from p. 72.

(the other pole being to earth) pressed upon the paper ribbon. As the ribbon was drawn forward whenever a perforation passed the point of the style, metallic contact between the battery and line wire was momentarily made, and a current transmitted to the distant station, the duration of the current being regulated by the length of the perforation in the paper—thus giving the dot and dash code. The message at the distant station was printed by chemical decomposition. A ribbon of paper, prepared by immersion in a solution of sulphuric acid and prussiate of potass, was drawn over a metal cylinder in communication with the earth, and pressing upon this chemically prepared paper was a metal style in connection with the line wire. When, therefore, a current is received by reason of the metal style at the transmitting station passing a hole and joining battery to line, the chemical preparation of the receiving ribbon is momentarily decomposed by the action of this current, and a darkish blue mark will appear on the paper ribbon of a length—either a dot or a dash—corresponding to the duration of the transmitted current.

William Sykes Ward's patent, by which signals were indicated by the deflection of electro-dynamic coils over the poles of fixed permanent magnets, already noticed (Fig. 18), followed in 1847. This patent became, in common with most others, the property of the Electric Telegraph Company by purchase.

Holmes's new form of coil and needle, introduced in 1848, dispensed with the inertia of the long five-inch astatic needle combination and great coil resistances of the existing double needle system, and combined a greatly increased speed of transmission with a reduced battery power, both results of vital importance. This modification of the astatic needle combination is shown at Fig. 31, drawn to actual size, as compared with the five-inch needle.

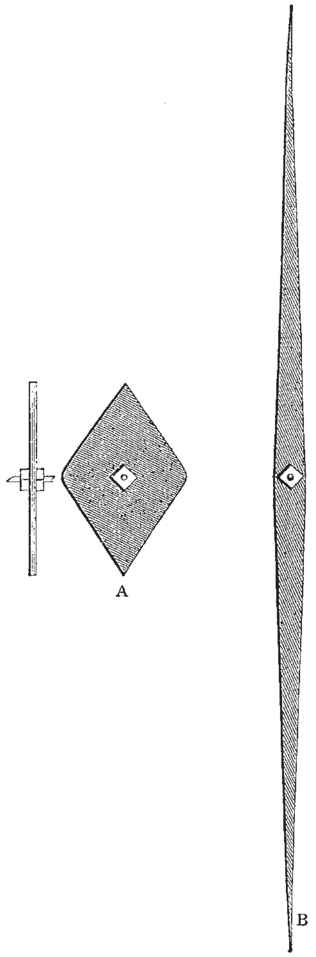

FIG. 31.—Holmes' diamond needle arrangement (A), dispensing with the astatic needle combination (B) and reducing the resistance of the coils. 1848.

The next patent brought under notice, that of Mr. W. T. Henley, led to the first serious opposition against the monopoly of the Electric Telegraph Company. In 1848 William Thomas Henley and George Foster brought out their improvements in electric telegraphs: this patent gave rise to the formation and establishment of a formidable rival in public favour to the Electric Telegraph Company, viz., the English and Irish Magnetic Telegraph Company. The improvements under this patent consisted in acting on a magnet, to the axis of which is attached an index or pointer by a single electro or other magnet, having each of its extremities converted or resolved into two or more poles. Fig. 32 shows the magnetic needle suspended between the poles of an electro-magnet, *a*, each pole being fitted with a piece of iron, of a segmental form, developing two similar poles. This magnetic needle is deflected in one direction for any length of time required by an induced magneto-current, it being brought back to its normal position by the reversed inductive current. The necessary magneto-currents to actuate the needle are produced from a magneto-electric arrangement consisting of two coils, A, A (on an armature), which are mounted on an axis, H, between the poles, M, M, of a permanent-magnet, and free to move in front of those poles upon depression of the handle, G, in such a manner that one pole of the magnet is not released from its opposition to the armature until the other just touches it, by which means currents of equal power and in opposite directions are produced. This arrangement of parts is shown in Fig. 33. These several representative improvements, selected out of the vast numbers that crowd the field up to 1848, will be sufficient for the purpose of tracing the Progress of the Telegraph.

Such were some of the instruments already invented when electrical communication was inaugurated in this country by the Electric Telegraph Company.

Proceeding down the *cul de sac* known as Founders Court, Lothbury, a stone façade, with the words "Central Telegraph Station" sculptured in bold letters, and massive oak doors, arrested the attention of the visitor. On entering, a noble and lofty hall with an enriched glass roof presented itself to view, with two long counters, one on either side, for the receipt and payment of messages. Behind these counters glass screens were placed with the names of the several stations open for messages painted in black letters upon them, the instrument rooms being behind the screens upon either side.

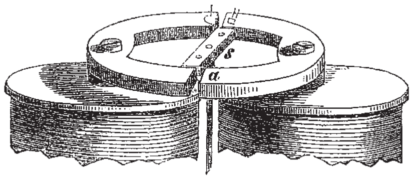

FIG. 32.—Henley and Foster's Magneto-Telegraph, 1848. Indicator movement.

The west side of the hall was devoted to correspondence with the northern and western districts, and the east side with the eastern and southern districts. Additional instrument rooms were provided on the first and second floors at the sides of the hall; and at the time of the opening of the station to the public, the Company had access to about sixty towns, with an extent of single wire along the railways of some 2,500 miles, and had a telegraph staff of fifty-seven hands appointed to the Metropolitan Station. The battery rooms, testing boxes, earth connections, and the tubes for bringing the wires into the building were situated in the basement underneath the great hall. The various wires were brought along the streets in pipes beneath the pavement. Twenty-seven came from the North Western Railway, nine from the South Western, nine from the South Eastern, nine from the Eastern Counties, nine from the branch office, 345, Strand, including those from Windsor, nine from the Admiralty, which with nine spare wires completed the circuit arrangements of the Company at the time that the telegraph was thrown open to the public. Many of the railway companies continued to reserve the use of their telegraphic lines to themselves; the Telegraph Company from the central station had therefore no power to forward public messages over such districts.

It is natural to suppose that great excitement and anxiety existed amongst the directors with reference to the opening of the building to the public for the receipt and transmission of messages. The disturbed state of

London at that time, arising from the Chartist demonstration and supposed possible attempt upon the Bank of England, by no means allayed the disquietude of the directors; as it was, most of the electrical staff had been sworn special constables, and truncheon in hand had assisted in guarding the principal buildings in the vicinity of the Bank of England and Royal Exchange. What if on the opening day a mob should rush in intent upon destroying the new-fangled invention! Such occurrences had been witnessed before. Had not Arkwright with his stocking loom, and Jacquard, incurred the fury of the ignorant artisans? Might not the rush of relatives and friends, merchants and bankers, all anxious to supersede the delays of post by the lightning speed of this new invention laid at their feet for the first time, prove so inconvenient to the clerks that all business would be interrupted, and the accuracy of the payments for messages and correctness of the transmissions be jeopardised? Besides, another evil rumour had gone abroad: light sovereigns and indifferent gold were in free circulation. Amongst all these troubles it is not to be wondered at, that as the eventful day drew near every precaution was taken to meet the assumed exigency of the occasion; sovereign scales were ordered, one for each counter already described. How could a clerk leave his place of trust to weigh a suspicious-looking piece of gold in scales situated on the opposite side of the great hall? The uniform shilling rate to all places from the metropolis did not at that time exist. Messages to Liverpool and Manchester were 8*s.* 6*d.* under twenty words, to Edinburgh 13*s.*, and to Glasgow 14*s.*; charges at that time considered very moderate, remembering the costly staff of clerks, the original outlay, wear and tear, &c. The great doors in Founder's Court were ordered to be kept fast bolted, and two port-holes cut some six inches square in the solid oak panels fitted with little screens opening inwards; so that whatever the crush in Founders Court, messages and money could be received inside through them and change given; in fact, the Central Telegraph Station was converted more or less into a fort prepared to stand a siege. The opening day came—scales on counter, change in tills, receiving and cashing clerks at their posts, every instrument and circuit along the respective railway lines proved for accuracy by the sending and receipt of test signals, staff at instruments, doors bolted. Nine o'clock strikes, port-holes opened, and, after the manner of the stage manager behind the curtain who surveys the patronage bestowed upon the boxes, stalls, and dress circle from his mysterious peephole, so did the expectant staff view the state of Founders Court through their port-holes. Not a person disfigured the symmetry of the lines of the flag pavement, save the Bank of England porter, performing his prescribed beat against the Bank wall. The sun marked midday,—afternoon,—evening,—and one paid message alone was transmitted to a station situated somewhere upon the Norwich circuit. Empty tills, idle clerks, disappointed directors. Such was the story of the opening day of the Electric Telegraph Company's Central Office. No one believed in it; it was regarded more in the light of a clever toy than a practical invention to be trusted or relied upon. This want of patronage from the public damped the ardour of some of the directors. The late Mr. Sampson Ricardo, walking into the central station the next morning, gave vent to his disappointment by declaiming on the extravagant expenditure of capital in two pairs of sovereign scales, demanding that one pair should be immediately returned to the scale-maker who had supplied the luxury.

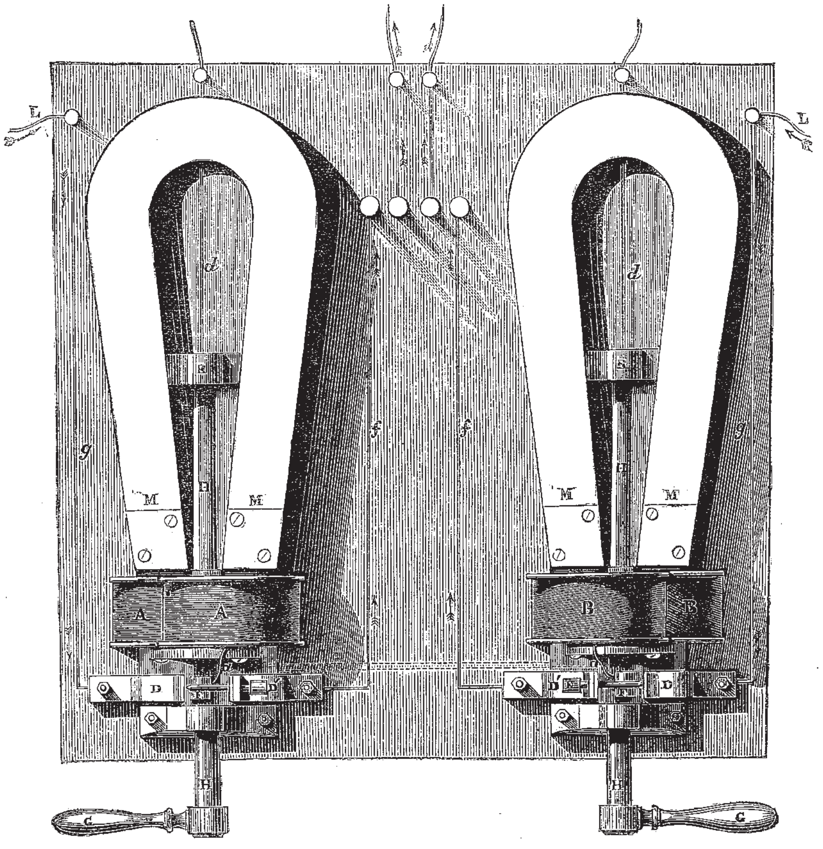

FIG. 33.—Henley and Foster's Magneto-Electric Telegraph, 1848. Plan of the magneto-coil arrangement for producing currents of equal intensity in opposite directions.

After the vast expenditure of capital in the purchase of the Cooke and Wheatstone patents, erection of lines over the kingdom, station inauguration, and the incorporation of the Company by special Act of Parliament, naturally the promoters of the Electric Telegraph Company endeavoured to create a monopoly in the transmission of messages for the public.

(*To be continued.*)

OUR ASTRONOMICAL COLUMN

THE TOTAL SOLAR ECLIPSE OF 1886, AUG. 29.—This eclipse will be a remarkable one, on account of the length of duration of totality, which will not fall far short of that of the eclipse of 1868, Aug. 18, though it unfortunately happens that its track is mainly over the Atlantic Ocean, and there will be no land station for physical observations while the sun is hidden for the longest interval. The elements of the eclipse are, very approximately, as follows :—

Conjunction in R.A. 1886, Aug. 29, at 0h. 57m. 37·7s. G.M.T.

	°	′	″	
R.A.	157	50	51·9	
Moon's hourly motion in R.A.		37	4·8	
Sun's „ „		2	16·7	
Moon's declination	9	10	38·4	N.
Sun's „	9	17	23·9	N.
Moon's hourly motion in Decl.		10	45·1	S.
Sun's „ „		0	53·4	S.
Moon's horizontal parallax		61	20·5	
Sun's „			8·8	
Moon's true semidiameter		16	42·9	
Sun's „		15	51·1	

The central eclipse begins Aug. 28, at 23h. 12m. 32s. G.M.T., in longitude 79° 33′ W., and latitude 9° 51′ N., and ends Aug. 29 at 2h. 36m. 28s. in longitude 47° 19′ E., and latitude 21° 57′ S., and the sun is on the meridian centrally eclipsed in longitude 14° 13′ W., and latitude 2° 58′ N. The following are also points upon the central line :—

Longitude.	Latitude.
66° 47′ W	11° 36′ N
61 1 W	12 6 N
11 9 E	11 5 S
20 10	14 52
21 39	15 25
25 5 E	16 36 S

It would appear from this track that the only easily accessible station where the sun will be at a sufficient altitude will be at the southern extremity of the Island of Grenada, in the West Indies; for which point, assuming its longitude 4h. 6m. 20s. W. and latitude 11° 59′ N., we find—

	H.	M.	S.	
Beginning of totality, Aug. 28, at	19	10	7	Local mean times.
Ending „ „	19	13	22	

The duration is therefore 3m. 15s., and the sun's altitude is about 20°.

If we take for a point where the sun will be near the meridian, longitude 0h. 50m. 52s. W. and latitude 2° 8′ N., we have—

	H.	M.	S.	
Beginning of totality, Aug. 29, at	0	8	48	Local mean times.
Ending „ „	0	15	14	

The duration of total eclipse, which is here nearly at its maximum, is therefore 6m. 26s., and the sun at the time is only 7° from the zenith.

From this point the length of totality diminishes, until, during the passage of central eclipse over Southern Africa from near St. Philip de Benguela to the Mozambique, it is comparatively short. It will be seen that the central line runs considerably to the north of the islands of Ascension and St. Helena.

The middle of general eclipse occurs at 0h. 54m. 30s. G.M.T.; the sidereal time at Greenwich mean noon is 10h. 30m. 27s·8, and the equation of time 0m. 46s. subtractive from mean time, figures which may facilitate a further examination of the phenomenon.

THE SUN'S PARALLAX.—Prof. Galle, Director of the Observatory at Breslau, in a letter to M. Leverrier, gives the definitive result of his discussion of observations of the minor planet Flora (Hind, 1847, Oct. 18) in the autumn of 1873, at observatories in both hemispheres, with the view to a determination of the solar parallax. The receipt of particulars concerning some doubtful observations at Melbourne and other stations had enabled him to apply some small corrections, by which, however, the value of the sun's parallax published in No. 2,033 of the *Astronomische Nachrichten* is but very slightly changed. Prof. Galle now finds from eighty-one corresponding observations between the two hemispheres, forty-one stars of comparison to the north of the planet and forty to the south, that " the definitive result for the solar parallax should be fixed at $\pi = 8''\cdot873$, with a very small uncertainty in the hundredths of the second." He adds, that of ninety-six corresponding observations in all, he had excluded fifteen on account of some discordances arising from imperfections in the southern instruments, but even if these fifteen observations were included, the value is only changed to $8''\cdot878$. Prof. Galle is engaged in the composition of a memoir giving full details of his investigation. He remarks upon the close agreement of his result with that obtained by the numerous and very exact measures of the velocity of light, by M. Cornu, at the Observatory of Paris, with the theoretical determination of M. Leverrier from the perturbations of the planet Mars, and with M. Puiseux's first result from observations of the transit of Venus at Pekin and St. Paul Island. He directs attention to the circumstance, that another favourable opportunity of applying the method which has furnished a value for the sun's parallax by observations of Flora in the northern and southern hemisphere, so nearly in agreement with values deduced in other ways, will be afforded about the opposition of Eurydice (Peters, 1862, Sept. 22), which occurs on the 20th of September next, when the planet will be a bright ninth magnitude. It will be in perihelion early in the previous month, and at its nearest approach to the earth on Sept. 13, will be distant less than 0·878 of the earth's mean distance from the sun. Prof. Galle hopes to secure on this occasion the co-operation of the astronomers who have taken part in the observations of Flora.

THE MINOR PLANETS.—On comparing elements of this group as known to the present time, it appears that *Flora* has the shortest period of revolution, 1193 days, and of those which have been satisfactorily calculated, *Sylvia* has the longest, 2374 days, the corresponding mean distances, expressed in parts of the earth's mean distance from the sun, being 2·201 and 3·482. The nearest approach to the sun is made by *Phocea*, 1·787, while *Freia* recedes furthest from him, the aphelion distance being 4·002. We may add to these the following values near the extremes of distance :—

	Distance in Perihelion.		Distance in Aphelion.
Melpomene	1·796	Sylvia	3·757
Clio	1·805	Cybele	3·803
Victoria	1·823	Pales	3·810
Iris and Ariadne ...	1·835	Euphrosyne	3·849
Eurydice	1·854	Hermione	3·882
Flora	1·856		
Polyhymnia	1·890		
Virginia	1·899		

Polyhymnia has the greatest excentricity, 0·33998, and *Lomia* the least, 0·02176; *Pallas* the greatest inclination, 34° 42′, and *Massalia* the least, 0° 41′. It will be seen that the difference of distance from the sun between Phocea in perihelion and Freia in aphelion is 2·215, corresponding to about 204,000,000 miles.

M. Leverrier's *Bulletin International* of June 5 con-